QuikChem® AE

Automated Ion Analyzer

- Flow Injection Analysis
- Ion Chromatography

LACHAT
INSTRUMENTS

The Accuracy You Demand. The Speed and Simplicity You've Been Waiting For.

Introducing the most advanced automated ion analyzer available — QuikChem® AE — the Advanced Edition of the respected QuikChem Automated Ion Analyzer. Combining the powers of flow injection analysis (FIA) and ion chromatography (IC) in a single instrument, QuikChem AE provides your laboratory with maximum flexibility and minimum complexity.

QuikChem® AE Automated Ion Analyzer

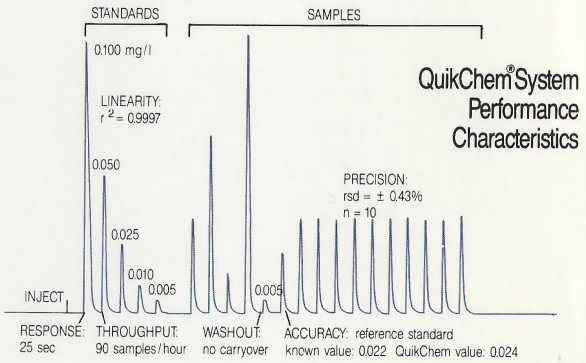
The primary goal in designing the QuikChem AE — the Advanced Edition of the well-respected QuikChem System — was to add features which combined to minimize the requirement for operator intervention during a run. The AE delivers a new level of automation by eliminating the need for the operator to perform several functions. These include performing dilution of off-scale samples and re-running them and monitoring data quality and taking remedial action.

As with the original QuikChem System, the AE offers unmatched versatility in ion analysis with the ability to determine a wide concentration range of analytes in a diversity of sample matrices. Whether you need to determine one or many ions, in simple or complex matrices, at ppb or percent concentrations, the sensitive and selective QuikChem chemistries provide the highest degrees of accuracy and precision available.

Flow Injection Analysis

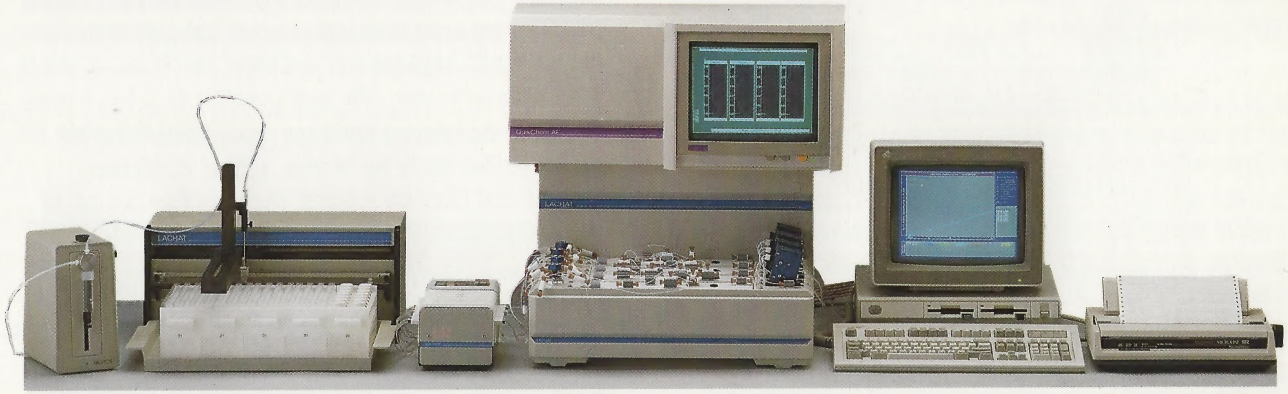
The accuracy and productivity of the highly engineered QuikChem AE can be traced to its remarkable flow injection technology. Samples are introduced by injection and carried through the system by an unsegmented continuously flowing carrier stream. Because there are no bubbles with the QuikChem system, your operation flows smoothly, unimpeded by delays in attaining, and maintaining, bubble equilibrium.

A hallmark of flow injection analysis is efficient inter-sample washout. This feature is the basis for many of the unique benefits that the QuikChem system brings to your laboratory. These benefits include highly accurate determinations, real-time reporting, no requirement for post-run correction of data for baseline drift, sensitivity drift and carryover and intelligent closed-loop dilution of off-scale samples.



Determination of low level ammonia in estuarine water.

The New Standard For Productivity



Capabilities You've Come to Depend On

The original QuikChem system introduced in 1981 provided these important benefits to the analytical laboratory:

- **High sample throughput**
Typically, between 90 and 120 samples per hour can be processed.

- **Fast startup**
In under 5 minutes reagents are pumped into the system, the baseline is stabilized and the analyzer is ready to go.

- **Short analysis times**
Following injection, the sample is processed through FIA manifolds in less than 1 minute.

- **Rapid method switching**
In less than 15 minutes one method can be shutdown and another started up.

- **Real-time reporting**
No waiting for results. All computations are made immediately after each sample is processed including corrections for baseline drift, calculations of dilution factors, weight factors, inter-channel relationships and user programmed functions.

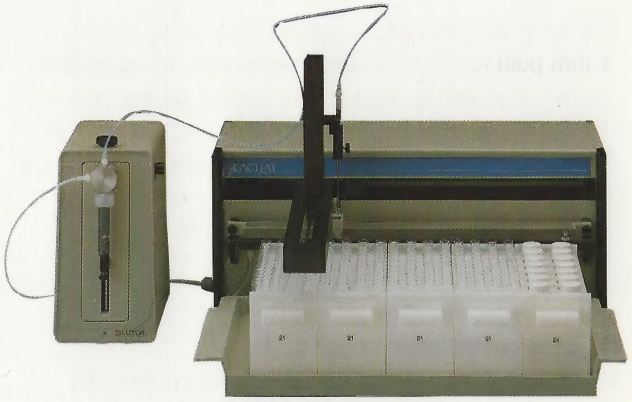
- **Automated Data Quality Monitoring and Control**
Statistically-based run-time diagnostics continuously monitor accuracy and precision and take corrective action as required.

With the introduction of QuikChem AE, unparalleled automation is now at your fingertips with all of the features of the original QuikChem plus:

- **XYZ Sampling**
The Automated XYZ Sampler offers true random access to both samples and standards to enable replicate sampling, data quality monitoring and recalibration as required. The XYZ accommodates bulk solutions of both calibration standards and quality control samples including blanks, spikes, duplicates, knowns and check standards. This preserves valuable sample positions and obviates the need for the analyst to repour these commonly used solutions.

Operating in conjunction with the Automated Dilution Station, the XYZ Sampler also automates intelligent sample dilutions. The QuikChem AE software employs a proprietary algorithm to estimate the concentration of off-scale samples and calculate the optimal dilution ratio to bring the analyte concentration within the working range of the chemistry.

XYZ Sampler shown with five racks to accommodate any combination of samples and standards.



• Automated Dilution

With the QuikChem AE, samples with highly concentrated analytes can be determined in the same run as trace level samples with no operator intervention. No more off-scale samples and manual dilutions. Any combination of gradient, physical or optical dilutions can be used to determine analytes over a range of up to seven orders of magnitude.

QuikChem AE's proprietary gradient dilution technique can be used with many chemistries to determine analytes over a three decade range. Gradient dilution uses the area of the trailing portion of the analytical peak to either determine or estimate, as programmed by the operator, analyte concentrations when the central portion of the peak is off-scale.

Three additional decades can be accommodated by interfacing with the Automated Dilution Station. With this option, samples can be automatically diluted from 5:1 to 1000:1. The diluted samples are then re-run and the results integrated into a final sample report. The operator can also specify that certain samples be diluted by a given ratio before they are determined during the initial run.

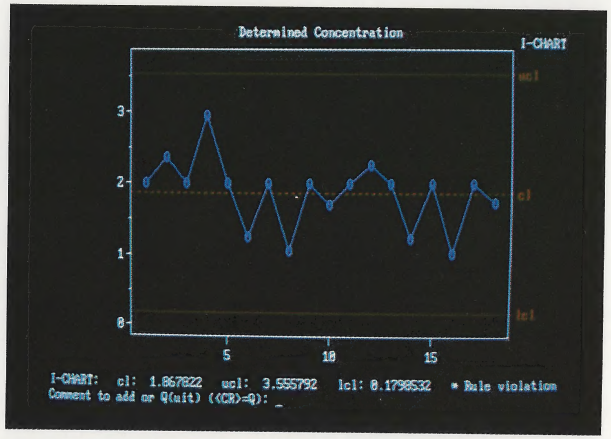
Finally, a seventh decade can be attained by placing a 1 mm path length flow cell in series with the standard 10 mm flow cell to effect a 10:1 optical dilution. Each analytical channel can accommodate two detectors so that optical dilution can be performed using only a single channel.

• Closed-Loop Quality Control

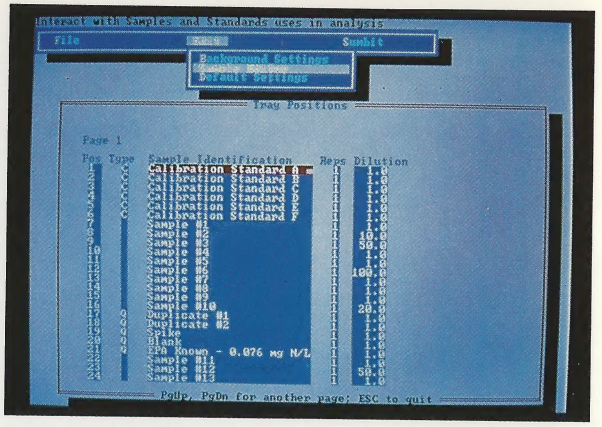
Imagine data quality being assured with no operator intervention. Available exclusively on the QuikChem AE Automated Ion Analyzer, the analytical process is not only continously monitored, but also controlled.

Flow injection analysis can be viewed as a continuous chemical process wherein a sample is mixed with one or several reagents. For each sample, the software monitors the residence time and peak shape. Since the sample residence time in an FIA manifold is so short, usually under one minute, problems can be detected almost as soon as they occur and before other samples are processed.

As part of the method definition, the operator can set quality control limits for blanks, spikes, duplicates, knowns and check standards. Then, as they are run at user-defined intervals through random access to bulk solutions, these QC samples are determined. If the determined values are beyond the operator-defined QC limits, the system will take prompt remedial action. While this action can be selected by the operator, it usually involves automatic recalibration and reanalysis of the samples bracketed by the QC sample that passed most recently and the one that just failed. It will then continue to run the remaining samples. All with no operator intervention.



Quality control chart showing periodic determinations of a known over one month.


Interact with Samples and Standards uses in analysis
File
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Background Settings
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Page 1
Pos Type Sample Identification Reps Dilution
1 C Calibration Standard A 1 1.0
2 C Calibration Standard B 1 1.0
3 C Calibration Standard C 1 1.0
4 C Calibration Standard D 1 1.0
5 C Calibration Standard E 1 1.0
6 C Calibration Standard F 1 1.0
7 Sample #1 1 1.0
8 Sample #2 1 10.0
9 Sample #3 1 50.0
10 Sample #4 1 1.0
11 Sample #5 1 1.0
12 Sample #6 1 100.0
13 Sample #7 1 1.0
14 Sample #8 1 1.0
15 Sample #9 1 1.0
16 Sample #10 1 20.0
17 Q Duplicate #1 1 1.0
18 Q Duplicate #2 1 1.0
19 Q Spike 1 1.0
20 Q Blank 1 1.0
21 Q EPA Known - 0.076 mg N/L 1 1.0
22 Sample #11 1 1.0
23 Sample #12 1 50.0
24 Sample #13 1 1.0
PgUp, PgDn for another page; ESC to quit

A set of quality assurance samples can be specified as part of the method and placed in a single location on the XYZ Sampler. Each time the QA set must be run, the sampler simply returns to a single location. This technique saves analyst's time in pouring and positioning QA samples and minimizes the number of sample positions required.

• Multi-Channel Analysis

Now up to seven analytical channels can operate in parallel. They can be used in any combination of flow injection analysis and ion chromatography (see the Ion Chromatography Option section below) as well as to accommodate sample/blank channels and difference chemistries. In addition, each channel can have two detectors which can be connected fluidically in series to perform optical dilution without using a separate and valuable analytical channel.

Whether you want to determine seven analytes simultaneously, run FIA and IC sequentially or dedicate analytical channels to one chemistry, the QuikChem AE provides you with the maximum in flexibility.

QuikChem AE Calibration Report
09/02/1988 11:00
Method: Ammonia / Tray Template: 8802220B / Calibration Ref.: 8804130A.001

Calibration Statistics for Channel 1: Ammonia

Seg: 1 Slope: 250.13 Intercept: -0.70 r2: 0.99997

Std	Ave Rspns	Known	Derived	%Res	Rspns 1	Rspns 2	Rspns 3
A	4011	3.000	3.001	0	4012	4011	4011
B	2006	1.500	1.502	0	2005	2006	2007
C	668	0.500	0.511	0.2	668	668	668

Seg: 2 Slope: 257.75 Intercept: -0.82 r2: 0.99998

C	668	0.500	0.511	0.2	668	668	668
D	265	0.200	0.192	0.5	263	267	265
E	68	0.050	0.062	2.0	67	68	68
F	8	0.010	0.012	20	10	8	6

QuikChem AE Sample Report
09/02/1988 11:04

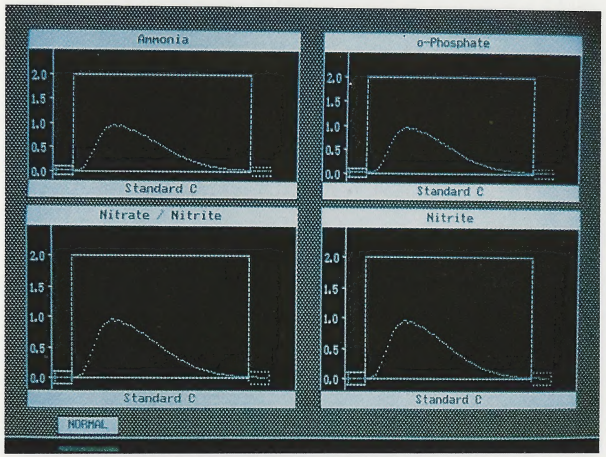
Method: Ammonia / Tray Template: 8802220B / Calibration Ref.: 880413A.001

Analyte -->	NH_3-N	PO_4-P	NO_3-N/NO_2-N	NO_2-N	NO_3-N
Units -->	mg/L	mg/L	mg/L	mg/L	mg/L
Sample I.D.					
ACX003LFL	0.531	0.003	0.012	0.002	0.010
ACX003WIN	1.433	0.504	1.345	0.256	1.089
ACX003WEF	0.223	0.051	0.323	0.167	0.156
ACX004LFL	2.021	0.113	0.239	0.022	0.217

Example of standard calibration and sample reports generated by QuikChem AE. User-defined reporting formats are also available.

• Automated Instrument Setup

Using sophisticated algorithms, the QuikChem AE automatically sets instrument parameters for each method including baseline, detector gain and control timing. The setup routine also does a thorough analysis of such things as peak shape and sample residence time, compares them to previously determined, known characteristics and determines that the instrument is ready to run. If any problems are detected, they are spelled out in English together with recommendations for corrective action.

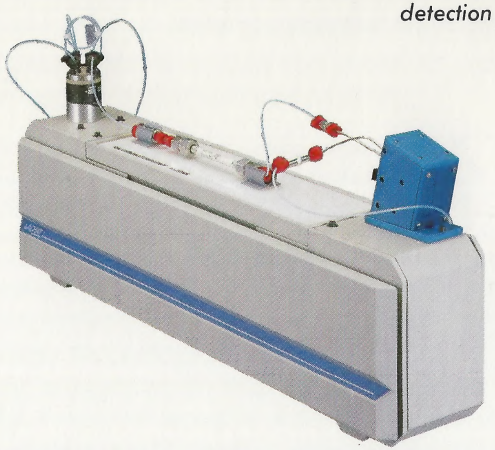


The PC integrated with QuikChem AE monitors and controls all run-time events.

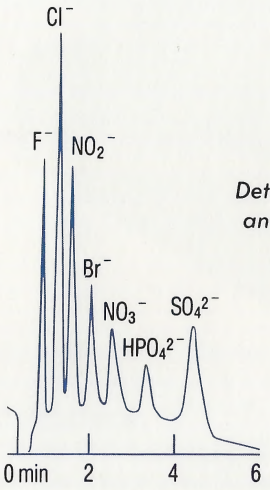
• The Ion Chromatography Option

The QuikChem AE also offers the capability of performing ion chromatographic (IC) separations. Whether you are profiling the basic anions, alkali metals, alkaline earths or transition metals, the QuikChem Ion Chromatography Option provides fully automated chromatography from sampling thru sophisticated post-run data manipulation and re-integration.

Perform state-of-the-art IC with your choice of UV-Vis or conductimetric detection methods.

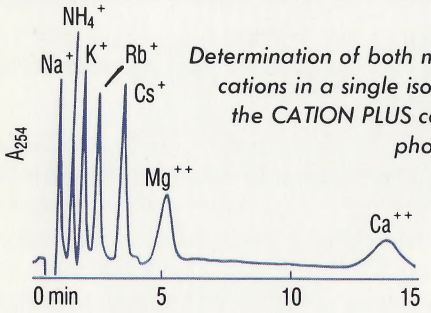


For example, if you are analyzing drinking water for inorganic contaminants, a single injection can determine fluoride, chloride, nitrite, bromide, nitrate, phosphate and sulfate using the Anion Profiling Module.



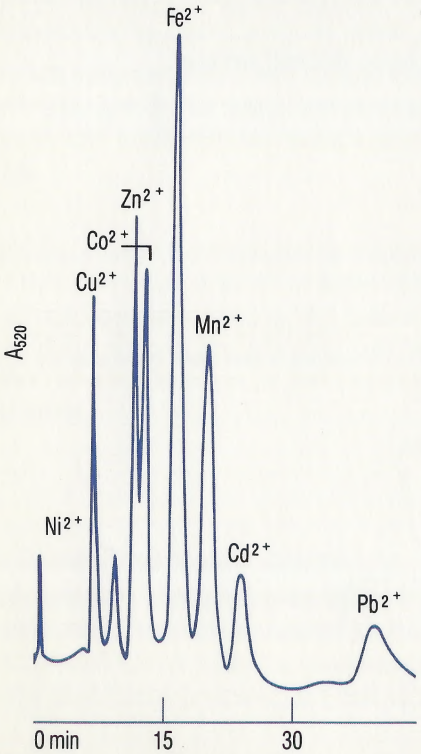
Determination of common inorganic anions in less than 6 minutes by IC.

By switching to our Cation Profiling Module, you can determine **both** alkali metals and alkaline earths in a **single** isocratic separation using your choice of photometric or conductimetric detection.



Determination of both mono- and divalent cations in a single isocratic elution using the CATION PLUS column with indirect photometric detection.

Using the same column with a different eluent, post-column derivatization and photometric detection, transition metals can also be profiled.



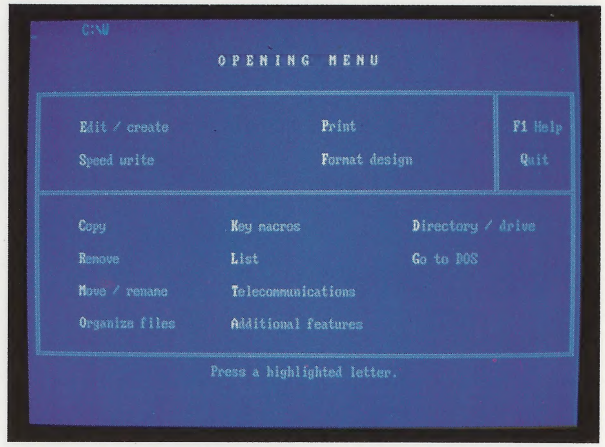
Determination of transition metals using the CATION PLUS column with post-column derivatization and photometric detection.

IC and FIA can also be used as complementary sample preparation techniques. For example, FIA can be used to pre-dilute samples and perform both pre- and post-column derivatization. In addition, IC can be used as a matrix modifier prior to FIA injection. Working together, IC and FIA provide a vista of opportunities for treating your toughest samples.

For complete information, please refer to the Ion Chromatography Option brochure.

• Multi-Tasking

QuikChem AE actually incorporates an IBM PC-XT compatible computer to perform all real-time functions including instrument control and data collection. This leaves your desktop PC available to perform other important tasks even while QuikChem AE is processing your samples. Now your computer is always available to run word processing, spreadsheet, database or other applications.



You can use your desktop PC for any normal function even while QuikChem AE is running.

A list of the most popular QuikChem methods. ▶

WATERS

Acidity	Cobalt	Nitrogen (TKN)
Alkalinity	Copper	Phenolics
Aluminum	Cyanide	o-Phosphate
Ammonia	Fluoride	Phosphorus
Bicarbonate	Hardness	Potassium
Boron	Hydrazine	Silica
Bromide	Iron	Sodium
Calcium	Manganese	Sulfate
Carbonate	Molybdenum	Sulfide
Chloride	Nickel	Sulfite
Chlorine	Nitrate	Zinc
Chromium (VI)	Nitrite	

BIOREACTOR SOLUTIONS

Amino Acids	Glucose	Lowry protein
Ammonia	Glutamate	Phosphate
Chloride	Glutamine	Reducing sugars
Citrate	Lactate	
Ethanol	dehydrogenase	

SOILS

Ammonia	Chloride	pH
Boron	Magnesium	Phosphorus
Calcium	Nitrate	Potassium
		Sulfate

PLANTS

Nitrogen (TKN)	Phosphorus	Sulfate

FEEDS

Crude protein (TKN)	Phosphorus	Calcium

FERTILIZERS

Ammonia	P_2O_5	Sulfate
Calicum	Potassium	

Other applications available upon request.

Accuracy and Precision

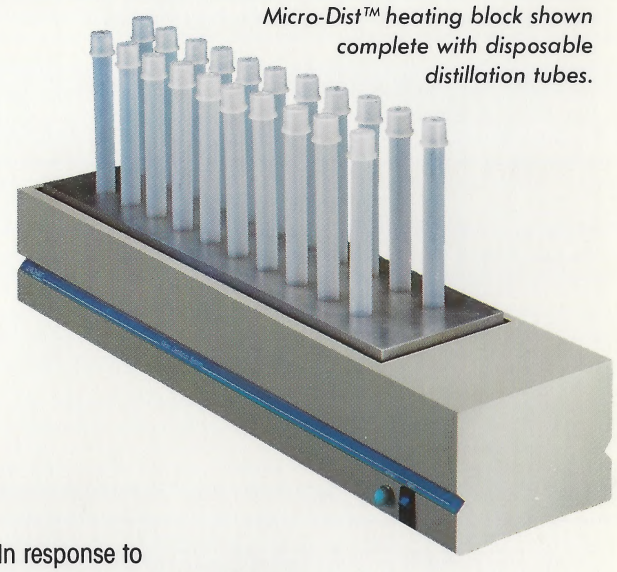
Lachat commissioned an independent environmental testing laboratory to evaluate the QuikChem methods for accuracy and precision. This study was done in the matrices of wastewater treatment plant influent and effluent and landfill leachates. In all cases, recovery and reproducibility were excellent. This data has been published as part of the **Compendium of QuikChem Methods** which is available from Lachat. An example of the reporting format used appears at left.

Example of reporting format for study of accuracy and precision of QuikChem methods.

Parameter: Ammonia		QuikChem Method No. 10-107-06-1-B				
Sample Type	**Sample Matrix**	**n**	**Mean**	**Standard Deviation**	**Percent Recovery**	**Standard Additions' Linear Regression**
Known (1.98mg/L)	WWTP Influent	1	—	—	104	—
	WWTP Effluent	1	—	—	106	
	Landfill Leachate	1	—	—	106	
Blank	WWTP Influent	—	0	—	—	$r^2 = 0.9999$
	WWTP Effluent	—	0	—	—	$r^2 = 1.0000$
	Landfill Leachate	—	0	—	—	$r^2 = 1.0000$
Blank 1	WWTP Influent	2	0.40	0.01	100	—
	WWTP Effluent	2	0.42	<0.01	105	
	Landfill Leachate	2	0.42	0.01	105	
Blank 2	WWTP Influent	2	0.82	0.01	102	—
	WWTP Effluent	2	0.84	<0.01	105	
	Landfill Leachate	2	0.85	<0.01	106	
Site A	WWTP Influent	4	17.38	0.09	—	$r^2 = 0.9999$
	WWTP Effluent	4	0.02	0.01	—	$r^2 = 0.9999$
	Landfill Leachate	4	63.58	1.18	—	$r^2 = 0.9980$
Site A 1	WWTP Influent	2	25.84	0.03	90	—
	WWTP Effluent	2	0.36	<0.01	85	
	Landfill Leachate	2	88.12	0.08	125	
Site A 2	WWTP Influent	2	33.81	0.07	88	—
	WWTP Effluent	2	0.70	<0.01	92	
	Landfill Leachate	2	107.76	0.01	114	
Site B	WWTP Influent	4	70.99	0.36	—	$r^2 = 0.9998$
	WWTP Effluent	4	1.16	<0.01	—	$r^2 = 1.0000$
	Landfill Leachate	4	337.98	1.49	—	$r^2 = 0.9984$
Site B 1	WWTP Influent	2	112.15	0.27	105	—
	WWTP Effluent	2	1.52	<0.01	93	
	Landfill Leachate	2	392.20	1.00	96	
Site B 2	WWTP Influent	2	153.26	0.74	105	—
	WWTP Effluent	2	1.89	<0.01	94	
	Landfill Leachate	2	458.20	0.93	106	
Site C	WWTP Influent	4	25.27	0.29	—	$r^2 = 0.9999$
	WWTP Effluent	4	0.79	<0.01	—	$r^2 = 1.0000$
	Landfill Leachate	4	78.16	0.19	—	$r^2 = 0.9992$
Site C 1	WWTP Influent	2	33.77	0.06	89	—
	WWTP Effluent	2	1.14	<0.01	81	
	Landfill Leachate	2	97.48	0.20	102	
Site C 2	WWTP Influent	2	41.96	0.04	107	—
	WWTP Effluent	2	1.50	<0.01	91	
	Landfill Leachate	2	119.59	0.16	107	
Check Standard (2.00 mg/L)	WWTP Influent	2	2.02	0.01	101	—
	WWTP Effluent	2	2.06	<0.01	103	
	Landfill Leachate	2	2.02	0.01	101	

Micro-Distillation Apparatus

For some analytes, including cyanides and total recoverable phenolics, samples must be taken through a complicated and time-consuming distillation process to remove the analyte from a potentially interfering matrix prior to automated analysis. This is incompatible with the high throughput capability of the QuikChem AE and becomes the limiting step in analytical productivity.



Micro-Dist™ heating block shown complete with disposable distillation tubes.

In response to the need for a more efficient sample preparation method, the **Lachat Micro-Dist™** system has been developed. This system provides a means for semi-automatically distilling samples prior to automated analysis.

Micro-Dist is a batch micro-distillation system using sample volumes of less than 10 mL. The key to the system is a disposable distillation tube assembly (patent pending). In practice, the sample is dispensed into a volumetric tube which is then inserted into a receiver tube containing a hydrophobic membrane. The assembly is then inserted into a heating block where the sample is boiled with the resulting vapor passing through the membrane, condensing and being collected above the membrane.

In less than an hour the distillation is complete. The tube is removed from the block, the distillate is brought up to volume and the tube is placed directly on the sampler for automated analysis.

Up to 21 tubes can be accommodated simultaneously by the heating block. Multiple inexpensive blocks can be used by laboratories with high throughput requirements. Thus, manual sample handling by the analyst is minimized. In addition, the sample is distilled under conditions that are significantly more reproducible than those involved in a macro-distillation procedure.

Summary of a study to evaluate the accuracy and precision of Micro-Dist.

RECOVERY STUDY OF SAMPLES DISTILLED USING MICRO-DIST™

Sample Number	Undistilled Value (mg CN^-/L) $\bar{x}(n=3)$	Distilled Value (mg CN^-/L) $\bar{x}(n=3)$	Recovery (%) $\bar{x}(n=3)$	Recovery (%) %rsd
1	0.499	0.501	100.3	0.6
2	0.204	0.197	96.6	0.5
3	0.096	0.103	106.2	1.0
4	0.101	0.101	99.7	0.6
5	0.049	0.049	100.0	<0.1
6	0.021	0.021	100.0	<0.1
7	0.009	0.011	122.0	10*
8	0.005	0.006	101.0	16*

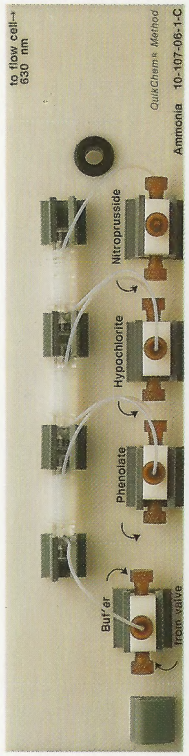
*High rsd's reflect operation at the detection limit of the method.

Standard and Custom Applications

We have over 150 standard chemistries available, including the applications listed in the table two pages back. In addition, our Technical Support Department regularly develops methods exactly to customer specifications —with guaranteed results.

Sample processing and reagent addition occur in the QuikChem Reaction Modules which are constructed of inert plastic components to make them chemically resistant, physically rugged, and inexpensive. The specially designed, quick-disconnect tube fittings allow fast, easy changeover from one chemistry to another — a feature that no other ion analyzer can give you.

QuikChem reaction module comprised solely of rugged, inert plastic components.



Designed for the Long Run

As your business evolves, so will the QuikChem system. The modular design allows you to purchase the system configuration you need now, with the option of upgrading as your technical requirements change.

The QuikChem AE Automated Ion Analyzer is ruggedly designed to prevent malfunctions, and if problems do occur, most are user-serviceable. The Lachat warranty is the best in the industry — if your system needs repair, we will loan you a working module free of charge — assuring you of a responsive and economical system at all times.

LACHAT
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